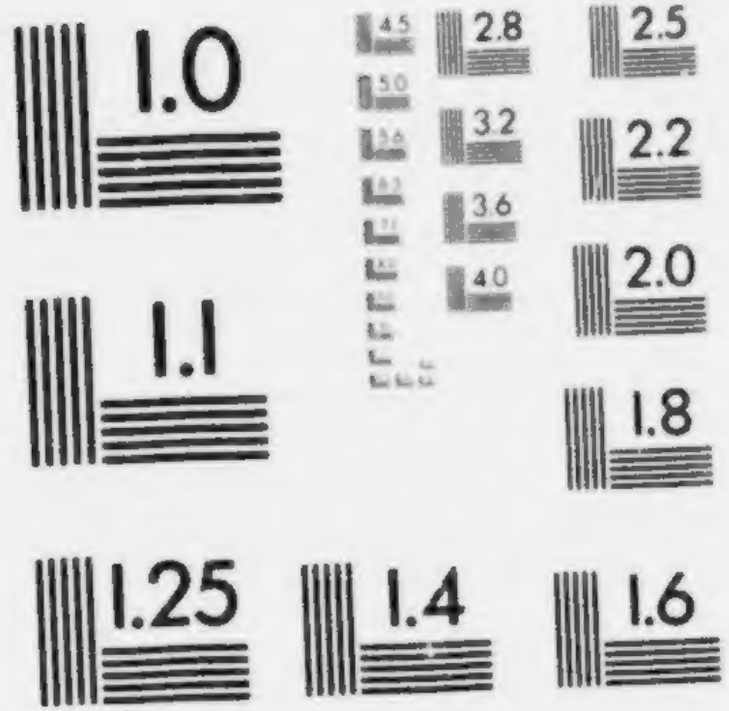
MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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Diseases of Forest Trees

AN ADDRESS DELIVERED BY Mr. H. T. GÜSSOW
BEFORE THE FIRST ANNUAL MEETING
OF THE COMMISSION OF CONSERVATION

Reprinted from the First Annual Report of
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DISEASES OF FOREST TREES

Considerable attention has been paid in the past to the study of forest tree diseases, especially in countries where it was realized that closing one's eyes much longer to the existing dangers would result in serious losses to trade and commerce. This extremely useful study has revealed to a considerable degree the economic importance of the disease-causing organisms which may attack our forest resources.

Unfortunately, as yet, very little attention has been paid to this subject in Canada. Canada's supply of timber has often been said to be inexhaustible, and practically anybody provided with the necessary capital and permission could go and fell trees to his heart's content. There was no question of selecting, of careful consideration or of economy; the future would take care of itself; there was enough forest land to supply the whole world with timber! Yet what is the good of closing one's eyes to the fact that it may take a day to pull down a tree, but many years to grow one?

I forget, however, that I am addressing the members of the Commission of Conservation, all of whom are far more familiar than I, with this method of silent devastation that has been practised for some time. It is my intention to speak on diseases of forest trees, and I have selected from among a large number a few that to me appear to be of the greatest economic importance.

As far as the maladies of other plants are concerned, the public have had their eyes opened and little urging is required to get them to employ the best means for checking the growth of parasitic fungi, which affect the pocket by injuring the crops, or diminish our enjoyment by disfiguring our fields and gardens. But, with regard to forest trees, there is a regrettable indifference, just as if diseases could not possibly harm them, and yet, severe losses do result annually from such fungus epidemics, which are in no way checked in their progress.

Speaking generally, the diseases of trees may be divided into two groups: First, those caused by mechanical or physical conditions; and second, those where parasitic organisms, such as insects and fungi, are the principal agents involved. With some of the more important insects, my colleague, Dr. Hewitt, Dominion Entomologist, no doubt will

deal, and hence the present remarks will be confined, for the most part, to diseases of forest trees caused by parasitic fungi.

It is a common observation that different types of soil and climate support different kinds of trees and other plants. The study of this subject has more recently engaged the attention of the Ecologist. But it is not always that we find certain trees growing in certain soils and under certain conditions, for the simple reason that man's efforts introduce trees into environments not peculiar to them. Nurseries and plantations of any kind supply excellent examples of their growing under conditions enforced upon them. Parts of our forests which have been cleared may again be desired to serve for the raising of young forest trees, and it is here where frequent failures are experienced. For we must bear in mind that the natural conditions are now totally changed; where formerly a humid atmosphere was present, we have now more air, and where natural shade prevailed, we have more light. The young plants that may be raised in such open woods are exposed to a marked degree to such physical influences, which would, under the old conditions, exert no injurious influence.

This exposure to physical conditions, however, is not the only factor which may induce disease; the trees are especially exposed to infections from other sources. There is particularly one fungus enemy of young seedling conifers which is known as the "Damping-off fungus." When the young seedlings have grown to a certain size under this new condition, it is by no means a rare occurrence that they suddenly begin to die in larger or smaller patches, and, if no means are employed to check this progress of dying off, soon all the seedlings will succumb, and any that are planted thereafter will fall victims to some mysterious foe. The cause for this sudden failure is now thoroughly understood; it has been found to be due to a microscopic fungus which attacks the young plants at the base and kills them with great rapidity. This disease in young coniferous trees is very serious, and it is fortunate that means have been discovered to prevent it. For although we shall not for some generations experience any shortage of forest supplies, providing, of course, that some method is discovered for fighting that arch enemy, "Forest Fire," we must bear in mind that planting young trees is the next important problem in the conservation of our forests. In some countries the annual planting of certain areas with young forest trees is enforced by legislation, and, on the whole, the lumberman is much checked in injudiciously cutting down timber trees. The best results in preventing the damping-off of coniferous seedlings were obtained by treating the soil several days before sowing the seed, by thoroughly drenching it with a solution mixed in the proportion of

one ounce of sulphuric acid to one gallon of water. This treatment was repeated about a week after the seedlings came up. Checkplots were used in these experiments which received no treatment and they had practically no seedlings left, while, in the treated plots, there was a good stand of fine healthy seedlings.

It is possibly due to the presence of this "damping off" fungus and its severe losses that, during recent years, large shipments of young forest trees have been imported into Canada from foreign countries, especially Europe. This importation is partly practised to obtain young seedlings of two or more years of age which are past the stage of infection from this fungus, and partly, because they can be obtained at such cheap rates that considerable time and money are saved. And certainly, nobody could raise any objection to these importations, although, quite recently, together with these seedling conifers, there is reason to believe, that a very serious disease was imported which may develop into a dangerous enemy to our white pine forests. This throws a very different light on the practice of importing seedlings. Unfortunately we have enough diseases of our own and do not want the introduction of new ones, which, like the new "blister-rust" of pines, as this disease is termed, would endanger not only the health of our seedling trees, but attack our own original resources in the shape of old trees, as well.

In the spring of 1909, 200,000 white pine seedlings were imported from Europe into Canada. These seedling plants were stated to be attacked by the fungus causing white pine rust, a disease which has caused great devastation amongst pines in many European countries. Unfortunately the pine seedlings were not carefully examined when imported, and were planted out. However, they are quarantined and are now closely watched. I will show you, later, a few lantern slides, one of which illustrates this disease and gives details of the life history of this parasitic fungus. During one stage of its growth the fungus is easily observed by the presence of numerous orange red powdery cushions growing from a blister or swelling on the stem of the young pine, but which will appear also on the branches and twigs of older trees. The fungus produces a large number of spores. of an orange red colour, masses of which form the clusters already described. Spores of fungi may be compared to seeds of higher plants, because they are capable of germinating similarly to seeds and thus, of course, disseminate and spread the disease. They are very minute, so that a single spore cannot be seen unless examined with a microscope. In consequence of their minuteness the spores are borne easily by the air and on windy days may be carried miles away from the infected areas. The disease, however, perpetuates itself, not only

by means of the spores, but also by the rootlike extremely delicate, microscopic tubes which grow in the tissues of affected plants and which will produce, in the subsequent season, a new crop of spores.

There is another factor peculiar to nearly all rust fungi which increases still more the serious nature of the disease. The spores of rust fungi generally pass through another stage in their life history upon other plants. Thus the white pine rust spores, when shed, are not capable of germination on other pines directly, but they attack all kinds of cultivated and wild plants belonging to the gooseberry or currant tribe. The leaves of these plants are necessary for a further development in the life cycle of this particular fungus. My illustrations will show you the effect of the spores on leaves of currants. Here the spores rapidly germinate, causing many small reddish pustules to appear on the surface of the leaves, and in these pustules another form of spore is produced, which, in conclusion of the cycle of the fungus, is capable of germinating only on pine seedlings. This process repeats itself with every new generation of spores on the pines. Thus we have : First, spores developing on the pine, then passing through the second stage on leaves of gooseberries or currants, where they produce another crop of spores, which return to the pines in continuance of their cycle of life.

I do not intend to describe the damage due to these spores on the berry bushes, but shall just say that the damage there may also be considerable. I have no doubt that you will agree that we have here to deal with a very serious enemy of our forest trees, and that my reference to this parasite will make forest nurserymen careful. Under no conditions should pines attacked by rust be planted, and precautions should be taken when importing young seedlings to obtain them from uninfected areas, or to have them examined on arrival in Canada by a competent botanist who is able to recognize the disease in all its symptoms. Since it is evident that pines and Ribes plants are both necessary to the development of the white pine fungus, the destruction of either kind of hosts must result in the extermination of the rust. Wherever the pines are attacked a search should be made all over the neighbourhood for Ribes and their destruction proceeded with.

A disease which seriously affects the value of timber occurs on our larches or tamaracks. I propose to give you a short account of the disease, which is known elsewhere as "larch canker." The same disease is reported to appear in the larch groves of North America and Canada, although practically no measures are employed on this side of the Atlantic to check it. The symptoms of this disease are the peculiar flattening of the trunk of larch trees, the copious outflow of resin and

the more or less complicated cankerous spots on the stems or branches of trees. If these affected parts are regularly examined, there may be discovered at certain times a small whitish cup-shaped fungus, growing on the surface of the diseased bark. I shall, later on, show you a slide or two illustrating the disease and its cause. The fungus caps grow from the roots or mycelium which lives in the bark of the trees, and thus they may be produced, according to the severity of the disease, in more than one place. The small cups may often be observed on all parts of the trees, even to the smallest branches.

When larch canker is present and this fungus spore germinates on the bark, it pushes out its germinal tube into the tissues of the bark, where it rapidly branches and permeates the bark and extends into the active layer below from which the new wood and bark is formed. In consequence of this irritation the bark is killed and the functions of the active layer underneath it are arrested. The fungus grows year after year and the portion killed increases in size. The tree now makes every endeavour to heal these wounds by sending forth from the edges of the wound numerous new cells which try to cover the diseased part. Curiously, this fungus has its active and its passive states; during the latter the tree exerts its powers in producing new tissues intended to cover the wound, which new tissues are vigorously attacked by the parasite during its activity. A natural consequence is the survival of the strongest. This battle may go on for years, but in very few cases, will the tree be the victor. My slides will show you some of the complicated results after a number of years of this battle for existence. The result of such infections of a whole plantation is of serious economic importance; the timber is practically useless as such, and trees frequently break off at the infected places through the weight of snow or by the force of the wind.

To prevent these serious complications the trees should be carefully examined when young, and, when the first symptoms of the disease are observed, the best method to arrest the progress of the parasite would be to cut away with a sharp knife all diseased bark down to the healthy tissues and paint the surface immediately with a coat of white lead paint.

These few examples may suffice to illustrate the seriousness of forest tree diseases caused by microscopic fungi. I will now refer to some diseases caused by the larger fungi which live on timber trees generally. These fungi may grow entirely on living tissues or they may occur on timber after it has been cut down. In both instances their economic importance is considerable. I have brought a specimen, which shows on the stem of a white birch a specimen of the wood

destroying fungi with which I intend to deal. The fruiting bodies of these fungi are familiar sights on dead and living trees, on railway ties, on the timber in mines, in houses, etc. I am sure every one of you will recollect having seen them actually growing. In either case, whether growing on dead or living wood, we find the wood cells filled with minute, fine threads which penetrate in all directions. The mycelial threads of the fungi concerned in these attacks secrete a ferment acting upon the contents of the living cell. In a short time the death of the cell results and ultimately of the tree. The mycelium may also be present in trees that have been cut down, or in logs, boards, etc., where it will continue to grow till the wood is wholly decayed, that is, when all substances are dissolved which the fungus uses for food. The decay is very rapid in the so-called sap wood of the tree, which contains considerable quantities of starches and oils, while it makes much slower progress in the heartwood. Not until the threads of the fungus grow out from the wood into the air will it be noticed that a tree is diseased. Up to that time there is no external evidence of disease. The threads which appear outside the bark of a trees give rise, in some cases, to a mere film, such as is shown growing on this specimen, or they may form complicated structures, usually called "toadstools," or those hard, brownish knobs called bracket fungus, a specimen of which I have shown growing on the birch. For a long time these objects were regarded as growing on the rotted wood, and it was not until recent times that we learned that the decay was due to them. From these remarks, you will understand that when you observe any "bracket" or other fungus growing out of the trunk of a tree, it is really badly decayed within. The structure of these fruiting bodies is very varied; my slides will show you the most common ones and also the damage due to them.

That you may understand how the disease of timber trees is spread, I beg your attention for a few moments to review the structure of some of these disease-causing organisms. The specimen on the birch which I have passed round shows on the lower surface a large number of small oval pores. Hence the scientific name of *Polyporus* is given to this particular fungus. When a section is made through this layer of pores one can observe, by the aid of a microscope, a number of very minute oval bodies which are the spores of this fungus. When these spores are liberated they may be carried to other trees, and if they find suitable conditions for their development, they will start the decay which makes progress internally. When it is later discovered that fruiting bodies of fungi appear on the stem or trunk, it is too late to save the tree. The spores prefer for their development a wound that may be

present on the bark of trees. In a forest, such wounds are very numerous, branches continually break off, woodpeckers make holes in stems in their hunt for trunk borers, boring beetles themselves puncture the bark, and there may be many other causes. Experience shows that open wounds are dangerous in plants, as they are in animals. Every surgeon recognizes the dangers attending upon wounds in animals, and, before the days of antiseptic treatment, the dangerous, and often fatal, results of operations were due, in many cases, to the infection of wounds by germs from the air. So with unattended wounds of trees. They may easily become infected with fungus spores or other disease germs, and with fatal results.

From these observations, it is evident in which direction salvation lies. And, if the Commission of Conservation would institute some method of inspection of forest reserves and plantations, it would be one of the most important steps in the direction of conservation of one of the most important natural resources of Canada.

In concluding my address I wish to make a few remarks on the relation of insects to forest tree diseases. My colleague, Dr. Hewitt, who will address you on problems of injurious insects of forest trees, will deal with them from the entomologist's point of view. I only wish to say that frequently one may observe fungi like *Polyporus volvatus* growing on branches and trunks of trees in a peculiar sort of arrangement. On careful examination, it has generally been discovered that the fruiting bodies of this fungus issue from the punctures in the bark caused by some bark or trunk-boring beetle. For this reason it is very evident that unless war is declared against the noxious insects, the plant pathologist cannot possibly suggest cures or prevention of diseases caused by fungi which gain an entrance through wounds caused by insects. I conclude my address by showing you some lantern illustrations which will bring home to you the urgent necessity of protecting our forests from the smaller and larger organisms that annually cause great losses, which, if expressed in figures, would amount to a surprisingly large sum.

After Mr. Güssow's paper, Dr. James Mills asked: Are these methods of fighting disease applicable to forests?

Mr. Güssow: Experience in other countries has taught that such is the case, but it is necessary to have a system of inspection such as they have in Germany. The forests are divided into certain districts and each district is inspected annually by officials who

have their men knock off every part which is infected, cut off the infected limbs or break off the fungus tops, so as to prevent fructification and consequent infection of the neighbouring trees.

Dr. Mills: Does it occur on the younger growth only?

Mr. Güssow: No, it occurs on all trees, young and old. It is not always the case that these fungi will appear on the branches high up. They are found from five to ten feet from the ground and are broken off with long poles to which weights are attached.

Dr. Mills: You think, then, it is possible to apply these methods to forests?

Mr. Güssow: Yes, but it would be necessary to have some method of forest inspection.

Dr Mills: Would the breaking off of the fungi destroy them?

Mr. Güssow: No, you must destroy them by fire.

Dr. Mills: Should not a tree so infected be marked?

Mr. Güssow: Yes, that is understood. They should be cut down as soon as possible, otherwise new fungus bodies will be produced.